AIR FORCE PLANT PJKS, SYSTEMS INTEGRATION LABORATORY, SYSTEMS INTEGRATION LABORATORY BUILDING
(Air Force Plant PJKS, Systems Integration Laboratory, Building T-28)
Waterton Canyon Road and Colorado Highway 121
Lakewood Vicinity
Jefferson County
Colorado

HAER No. CO-88-B

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Rocky Mountain System Support Office
National Park Service
P.O. Box 25287
Denver, Colorado 80225-0287

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HAER No. CO-88-B

Location: Waterton Canyon Road and Colorado Highway 121, Lakewood Vicinity, Jefferson County, Colorado

Date of Construction: 1960-61

Fabricator: Kaiser Steel Corporation, Fabricating Division, Montebello, California

Present Owner: U.S. Air Force

Present Use: Titan missile propellant systems testing, evaluation, handling, and storage

Significance: The Systems Integration Laboratory Building played a significant role in the development of the Titan II ICBM, which not only served as the largest and most destructive weapon in the U.S. nuclear arsenal during the Cold War (1962-87) but also functioned as a launch vehicle for the Gemini space program in 1965. The laboratory served as the functional center of the Systems Integration Laboratory complex for testing, handling, and storage of the Titan II's hydrazine- and nitrogen tetroxide-based fuel system propellants. Testing and evaluation of underground storage, temperature conditioning, and pressurized transfer of propellants, as well as rinse water collection and vapor disposal, in this building were critical to missile research and development and contributed to the success of the exceptionally significant Titan II program.

Historian: Harlan D. Unrau, National Park Service, Denver Service Center, 1999.

Description: Constructed in 1960-61 as part of the Systems Integration Laboratory complex, the Systems Integration Laboratory Building (T-28) is located on a bench approximately 500' east of the Cold Flow Laboratory (T-6) and uphill to the north-northeast of the Components Test Laboratory (T-27) at Lockheed Martin Astronautics. This structure contains 9,114 square feet of floor space and consists of two vertical cells that contain Titan II/Titan III Stage 1 and Stage 2 and Transtage "battleship" tanks and a gas generator enclosure for full-scale testing of the missile and launch vehicle propulsion systems. This building is linked to additional buildings in the Systems Integration Laboratory complex and serves as its functional center.

The building's basic structure is dominated by two welded structural steel gantries that are 75' high on the north side (Test Cell 6) and 40' high on the south side (Test Cell 7), respectively. The gantries support the two test cells (25'-0" x 25'-0") that contain

propellant tanks, instrumentation and control equipment, and propellant flow equipment. The Test Cell 6 structure contains the Stage 1 (propellant-filled) fuel and oxidizer "battleship" tank, which is approximately 58' in overall length and 10' in diameter. The Test Cell 7 structure contains the Stage 2 (propellant-filled) "battleship" tank that is approximately 21' in overall length and 10' in diameter. The Stage 1 "battleship" tank has support approximately 30' above the cell ground level grating, while the Stage 2 "battleship" tank has support approximately 20' above the cell ground level grating. The cell structures have gabled steel roofs and manually operated steel curtains that can completely enclose the structure. The curtains can be rolled up to permit natural ventilation.

The laboratory features vertical or horizontal small engine (to 10,000-pound thrust) hot firing areas, centralized instrumentation and control rooms, and 20,000-gallon propellant retention and disposal capabilities. When it was constructed, the laboratory building could conduct full-scale Titan outflows of 8,000 gallons per minute, while providing 5,000 pounds per square inch (psi) of gaseous nitrogen and helium and stored propellant conditioning.

The Test Cell 6 structure originally had work platforms at approximately 10', 22', 35', 53', and 65' above the ground working level grating. The design live load for the work platforms was 100 pounds psi. The work platforms were designed to allow for future dismantling and reassembly.

A metal stairway serves both cells. An "open-construction" elevator, approximately 4 square feet with a minimum load capacity of 2,000 pounds, is located adjacent to Test Cell 6 and extends to the top work platform.

The ground-working level at both cells, the high pressure gas generator enclosure between them, and the area in front of the cells to the apron paving (east side) is open steel grating. A platform for a nitrogen heater was originally located adjacent to the northwest side of Test Cell 6.

The splash area under the cells and for a distance of approximately 20' surrounding the cells is depressed and sloped at an approximate grade of 10 percent toward the sump. Splash paving and retaining walls are concrete with impervious treatment to prevent excessive decomposition from exposure to propellants. Diversion gates at the outlets of the sump direct propellant spills in the laboratory structure to their respective flumes and catch basins. Two oxidizer waste tanks were originally constructed downhill to the west-southwest, while a fuel waste tank was located downhill to the west-northwest.

A partially enclosed concrete enclosure is located between Test Cells 6 and 7 in which high-pressure gas tank and generator test firings are conducted. The enclosure only has two walls on the north and south sides -- the east and west ends are open.

Two 18" diameter burn-off ducts extend from each test cell to a point approximately 10' beyond the splash wall on the west side of the cells.

The laboratory building has undergone little structural modification since its construction, and onsite examination found no evidence of significant structural alterations. However, use of this structure to support testing of later launch vehicle systems, such as the Titan III and Titan IV, has resulted in upgrades and modifications to its technological systems and instrumentation.

History: The Systems Integration Laboratory Building was constructed on Air Force property adjacent to the Martin Company's Denver Division plant during 1960-61. In May 1960, the Martin Company contracted with the Kaiser Steel Corporation, Fabricating Division, of Montebello, California, to prepare the design specifications for and construct the laboratory facility as the functional center of the Systems Integration Laboratory complex for Titan II propellant testing. The specifications and design drawings, based on design criteria developed by Martin Company Cold Flow Laboratory personnel, were prepared by ARCAL, Engineers-Constructors of Pasadena, California, under a subcontract from Kaiser Steel. Initial construction operations began in late June or early July 1960. Construction was completed by early March 1961.

The facilities of the Systems Integration Laboratory Building were first used on June 7, 1961, when the Martin Company started its captive test program for the Titan II with the firing of a second-stage engine on nearby Test Stand D-1. Later on December 28, 1961, a Titan II missile underwent a complete captive-fired simulated flight in a static sequence test at the test facility.

The facilities of the Systems Integration Laboratory Building were utilized for testing Titan II propellants during 1961-64. The testing procedures involved the flowing of fuel and oxidizer through the numerous systems of the Titan II, including plumbing, control devices, ordnance, and electronics. The systems were tested for form, fit, and function as well as reliability to minimize failure of the expensive Titan II missiles. Subsequently, the facility played a significant role in propellant system integration evaluations for the Titan III and Titan IV launch vehicles.

Sources: Sources include architectural drawings, blueprints, and site plans in the Engineering Propulsion Laboratory and Plant Engineering and Construction Department at Lockheed Martin Astronautics. The corporation's Photographic Laboratory, Reproduction Services Department maintains an extensive collection of black and white and color photographs depicting construction, equipment, and testing activities at the laboratory building. Typescript copies of the contract and specifications for the structure may be found in the Archives of the corporation's Engineering Propulsion Laboratory.

Printed and/or published materials relating to the design and utilization of the structure include: "Criteria For the Design of XSM 68B Cold Flow Systems Test Laboratory and Components Test Laboratory, The Martin Company, Denver Division, Denver,

Colorado, April 15, 1960," Compiled by Cold Flow Laboratory Facilities Group (copy in Archives, Engineering Propulsion Laboratory, Lockheed Martin Astronautics); "Part II Valuations for Appraisal of Government-owned Test Area, Sections 20, 21, 28, 29 T6S, R69W, 6th P.M., Jefferson County, Colorado for Martin Marietta Corporation by Blaine B. Chase, MAI, SRA, and Wilson W. Wampler, July 1, 1971 (copy in Plant Engineering and Construction Department, Lockheed Martin Astronautics); and U.S. Department of the Air Force, Air Force Materiel Command, Aeronautical Systems Center, Wright-Patterson Air Force Base, Ohio and U.S. Department of the Army, Fort Worth District, Corps of Engineers, Fort Worth, Texas, Historic Building Inventory and Evaluation, Air Force Plant PJKS, Jefferson County, Colorado, prepared by EARTH TECH, Colton, California, and William Manley Consulting, San Diego, California, February 1997. Completion of the structure and its first utilization as part of the Titan II testing program are chronicled in "Main Area Profiles Change With Plant, Titan II Facilities," Martin Mercury 18 (10 March 1961): 2A, 2C; "First Titan II Propulsion System Test Firing at M-D," Martin Mercury 18 (16 June 1961): 2C; and "Titan II Passes Its First Captive Firing," M News 19 (12 January 1962): 1, 3.